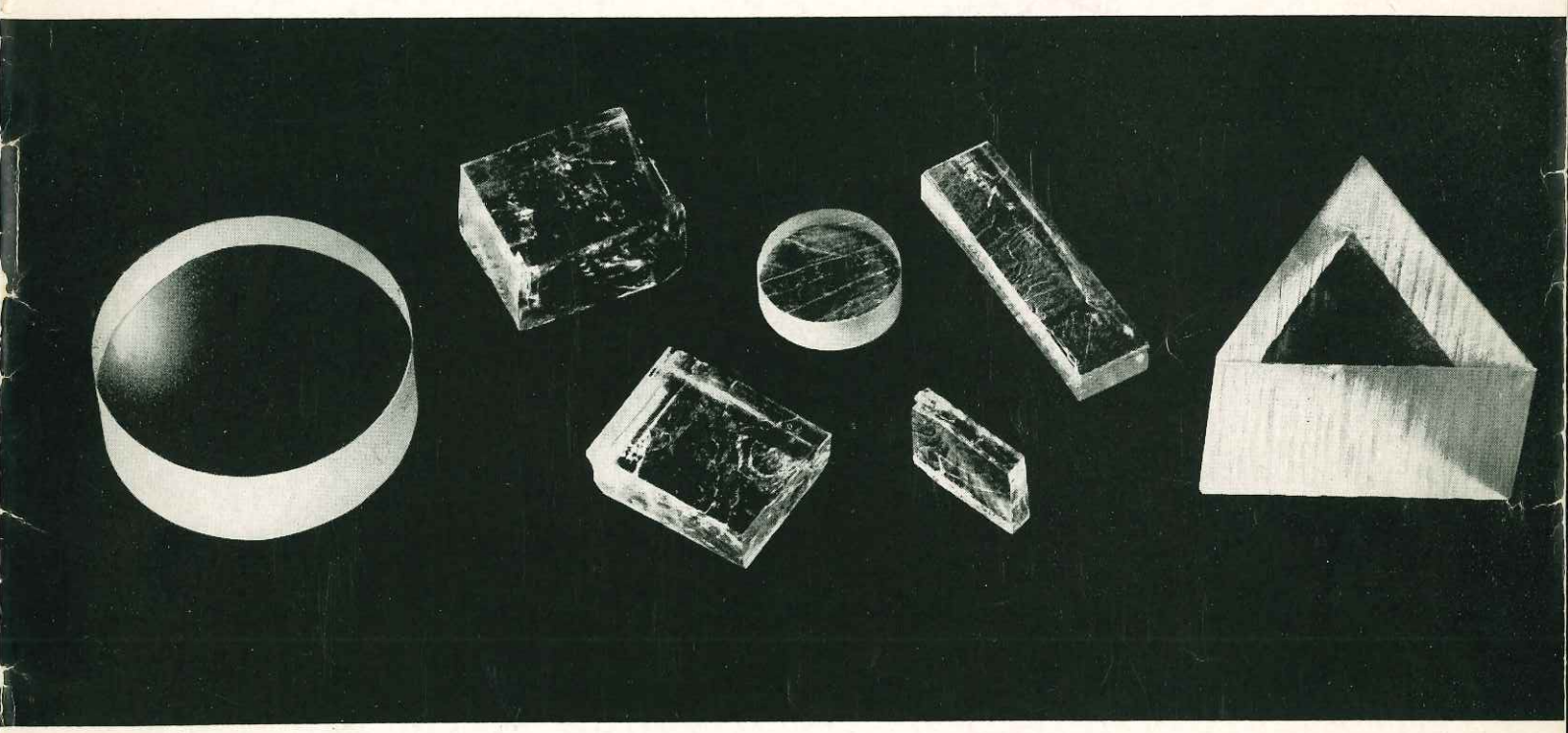
88/106 PUBL APRIL, 1957

ISOMET TECHNICAL BULLETIN 157 APRIL 1, 1957

350/2 350/112 359/355

SYNTHETIC OPTICAL CRYSTALS



APPLICATIONS

- ★ PRISMS AND WINDOWS FOR ULTRAVIOLET, VISIBLE AND INFRARED SPECTROSCOPY.
- ★ LENS ELEMENTS FOR ULTRAVIOLET AND INFRARED MICROSCOPY
- ★ LENS ELEMENTS AND WINDOWS FOR MILITARY INFRARED OPTICAL INSTRUMENTATION

DIVISION 7
APR 8 1960
U. S. PATENT OFFICE

O.L. 359/355

ISOMET CORPORATION
P. O. BOX 34, PALISADES PARK, NEW JERSEY, U.S.A.

Forms Available

PRISMS

Rough blanks sawn approximately 1 to 2 mm. oversize to allow for grinding and polishing to specified dimensions.

WINDOWS

a. Rectangular blanks cleaved or sawn to approximate size (1 to 2 mm. oversize).

b. Circular window blanks turned to exact diameter and faces either sawn or cleaved as specified.
Thickness is approximately 1 to 2 mm. oversize to allow for grinding and polishing to desired dimensions.

c. Polished rectangular or circular windows finished to exact specified dimensions.

RANDOM SIZES

All ISOMET optical crystals are available at low cost in random sized pieces suitable for experimental work.

Standard Sizes of Window and Prism Blanks

All Dimensions are in Millimeters

WINDOW AND LENS BLANKS

Diameter	*Thickness*
10	3
15	4
20	5
25	6
30	8
40	10
50	13
60	15
70	17
80	20
90	22
100	25

60° PRISM BLANKS

Will Finish to Following Sizes

Height	*Face*
10	15
20	25
30	40
40	60
50	65
60	75
80	100
100	150

General Properties

The choice of an optical crystal for any desired application will depend upon many factors such as the transmission and dispersion in the wavelength region to be used, the water resistance and the cost.

Crystals having a water solubility of less than 10 g./100 g. water are stable under normal laboratory conditions without the necessity of special precautions. However, for open air applications the solubility must be less than 0.01 g./100 g. water.

For the proper selection of prism material the disperision (dn/n) must be known. Figure 1 gives the dispersion coefficient for several commonly used optical crystals as given by Smakula[3].

The useful transmission range of various optical crystals is shown in Figure 2.

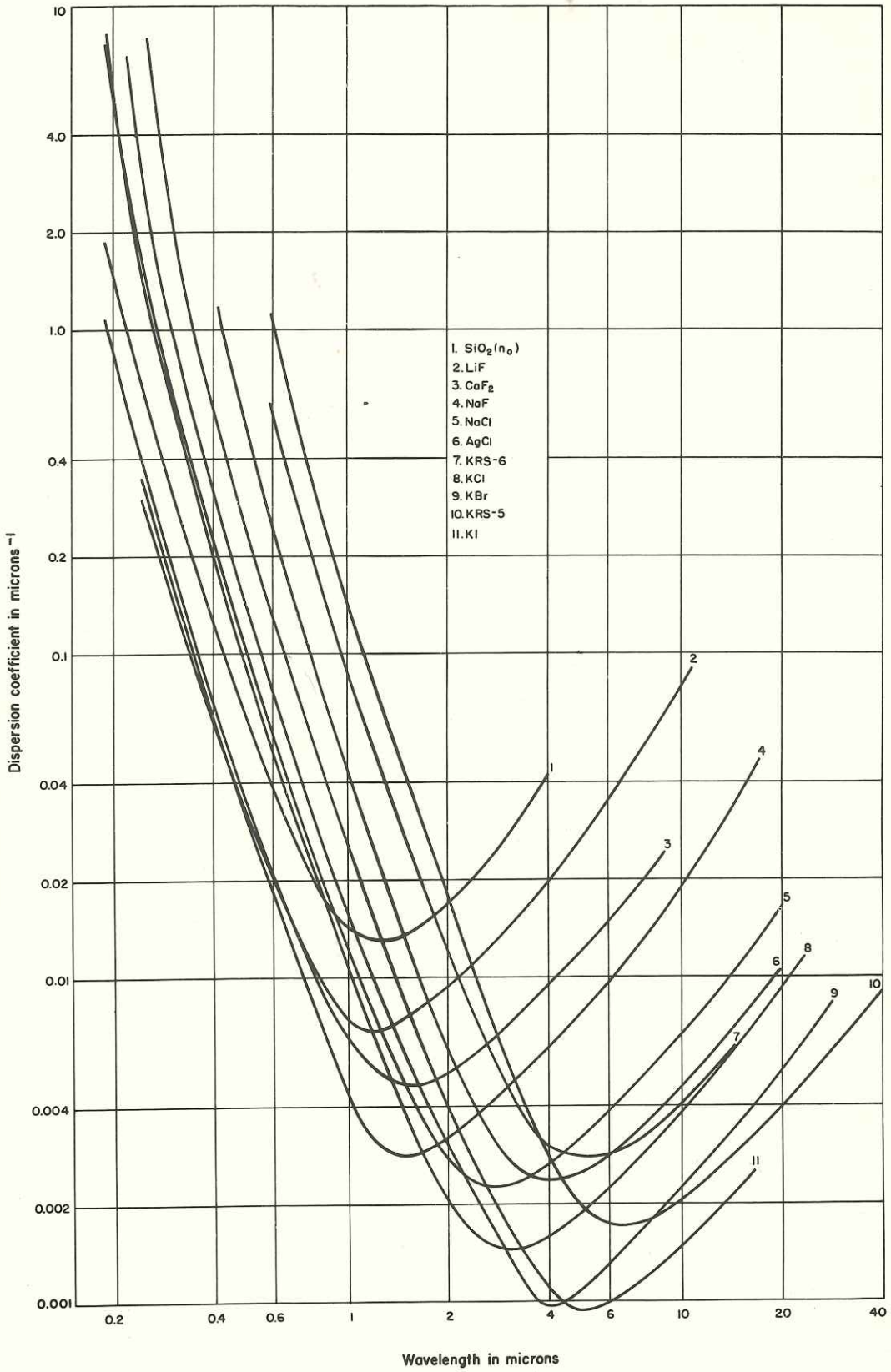


FIGURE 1. Dispersion coefficients of commonly used optical crystals as a function of wavelength.

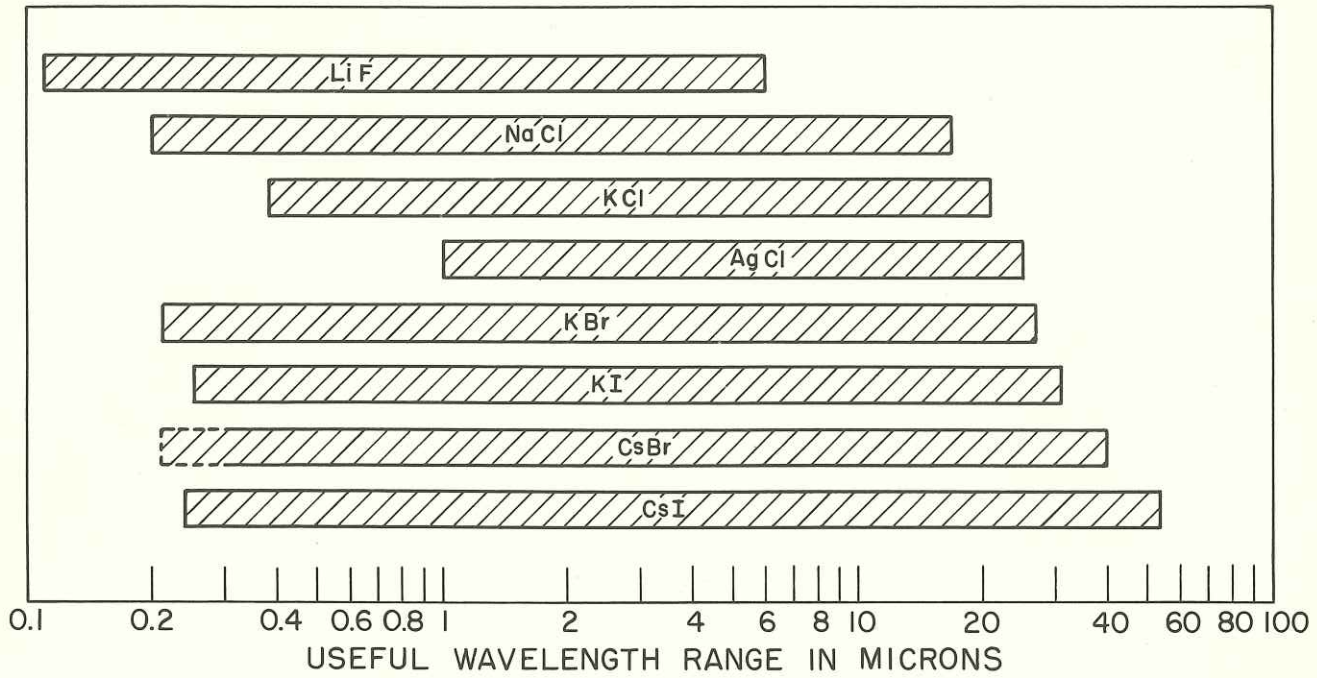


FIGURE 2. The useful transmission range of some optical crystals.

Sodium Chloride

CRYSTAL CLASS ..... Cubic

CLEAVAGE ..... Cubic

DENSITY 2.165

MELTING POINT ..... 801°C

SOLUBILITY IN WATER[1] ..... 35.85 g./100 g. water at 20° C

REFRACTIVE INDEX ..... Paschen[2] gives the refractive index of rock salt as 1.544313 at a wave length of 0.58932 microns at 18.0° C. A dispersion curve taken from Smakula[3] is shown in Figure 3.

TRANSMISSION RANGE ..... Harrison[4] gives the useful range as 0.20-17 microns. The infrared absorption of sodium chloride according to Joos[5] is shown in Figure 4.

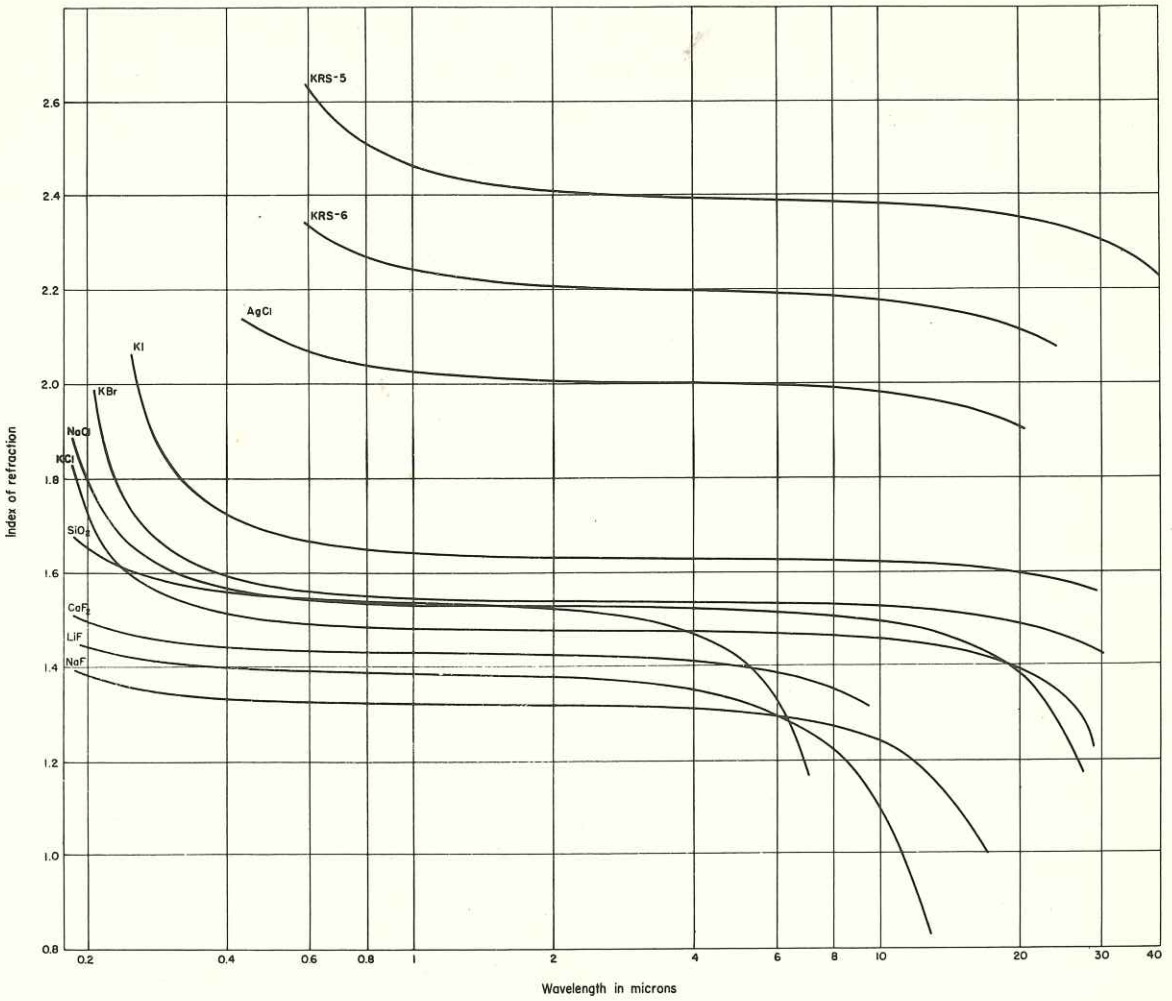


FIGURE 3. Refractive indices of some cubic crystals from 0.18 to 40 microns.

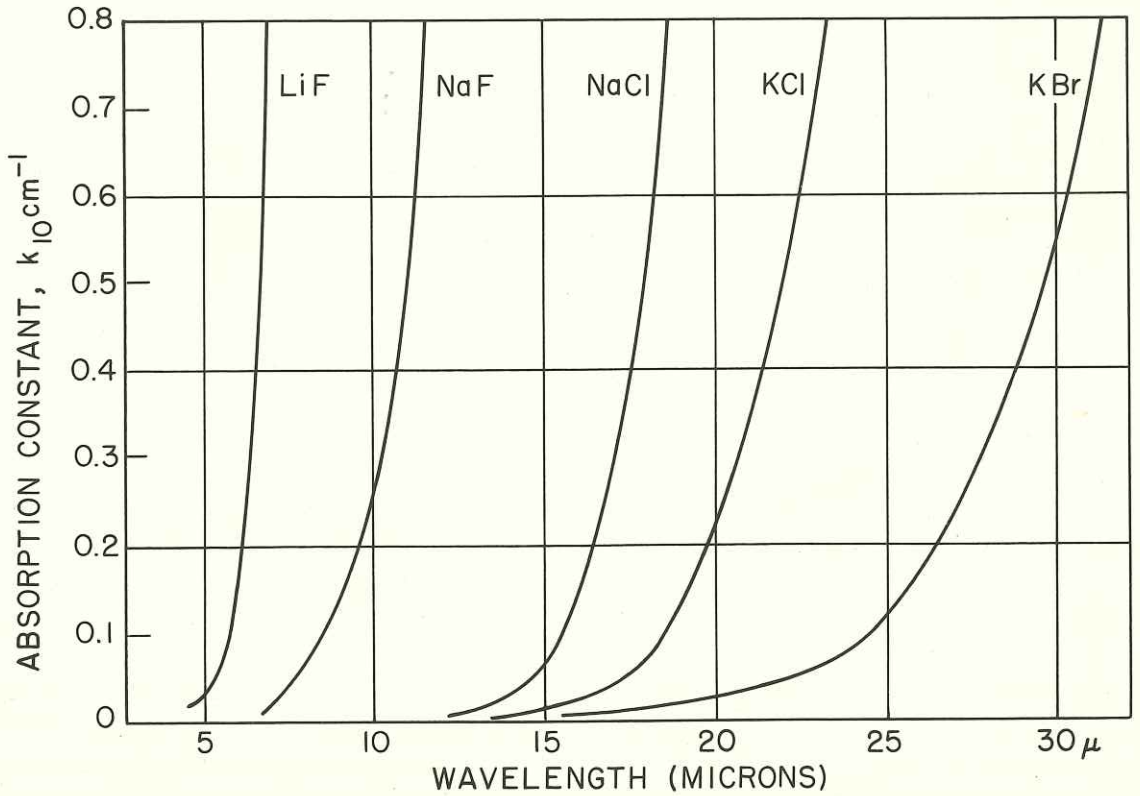


FIGURE 4. Absorption constants of some cubic crystals according to Joos.

Potassium Chloride

CRYSTAL CLASS	Cubic
CLEAVAGE	Cubic
DENSITY	1.984
MELTING POINT	776° C.
SOLUBILITY IN WATER[1]	34.35 g./100 g. water at 20° C.
REFRACTIVE INDEX	The refractive index as a function of wave length is shown in Figure 3.
TRANSMISSION RANGE	Harrison[4] gives the effective range as 0.38 to 21 microns. Absorption in the infrared is given in Figure 4.

Potassium Bromide

CRYSTAL CLASS	Cubic
CLEAVAGE	Cubic
DENSITY	2.75
MELTING POINT	730° C
SOLUBILITY IN WATER[1]	65.6 g./100 g. water at 20° C.
REFRACTIVE INDEX	The dispersion curve determined by Gundelach[6] is shown in Figure 5.
TRANSMISSION RANGE	The lower limit is 0.21 microns according to Melvin[7], while Harrison[4] gives the useful upper limit of KBr as 27 microns. Absorption in the infrared is shown in Figure 4.

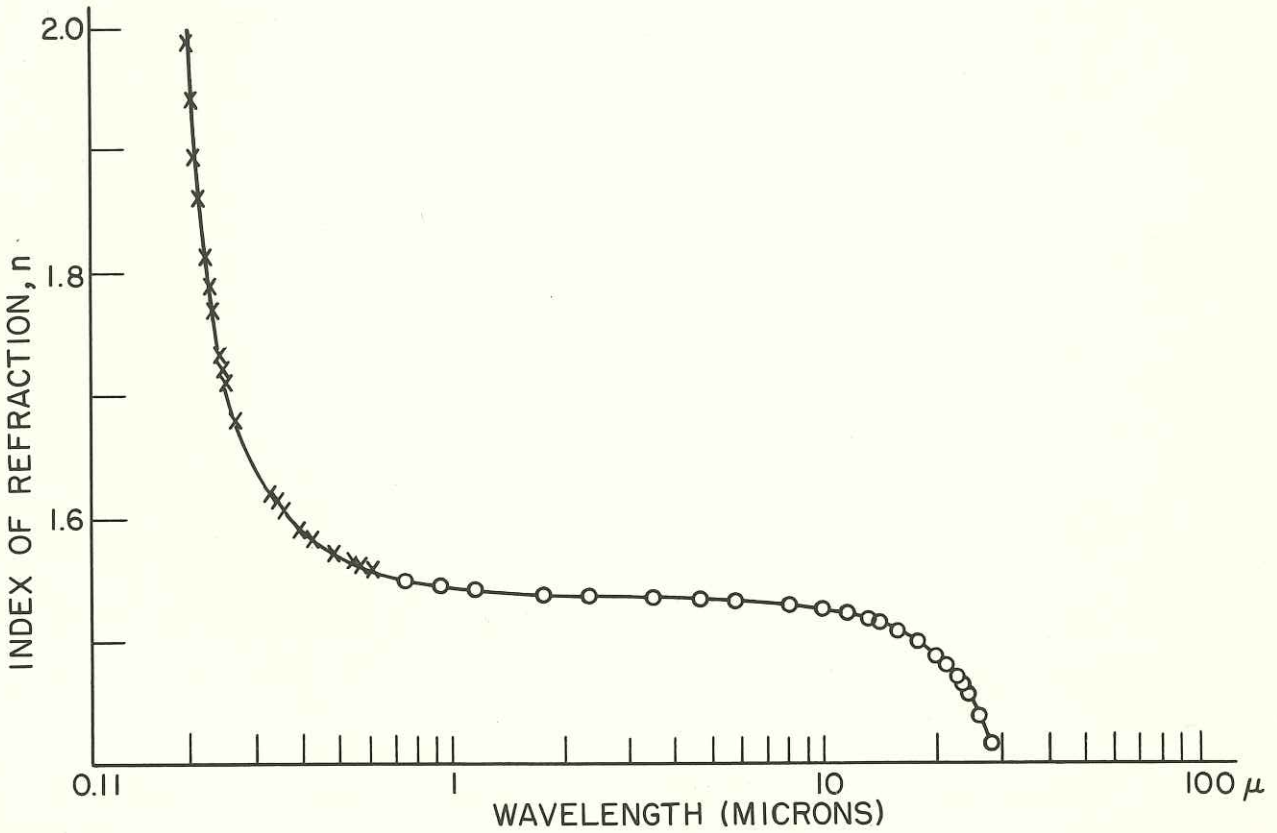


FIGURE 5. Dispersion curve of KBr as given by Gundelach

Potassium Iodide

CRYSTAL CLASS ..... Cubic

CLEAVAGE ..... Cubic

DENSITY 3.13

MELTING POINT ..... 723° C.

SOLUBILITY IN WATER[1] ..... 144.5 g./100 g. water at 20° C.

REFRACTIVE INDEX ..... Figure 3 shows a dispersion curve from 0.3 to 30 microns.

TRANSMISSION RANGE ..... Sawyer[8] reported the effective range as 0.25 to 31 microns.

Cesium Bromide

CRYSTAL CLASS ..... Cubic

CLEAVAGE ..... None

DENSITY 4.44

MELTING POINT ..... 636° C.

SOLUBILITY IN WATER ..... 124.3 g./100 g. water at 25° C.

REFRACTIVE INDEX ..... The index of refraction as a function of wavelength as given by Rodney and Spindler[9] is shown in Figure 6. A dispersion curve by these same investigators is presented in Figure 7.

TRANSMISSION RANGE ..... Plyler and Phelps[10] found that a 7 mm. thickness of CsBr has a transmission of 66.6% at a wavelength of 0.32 microns. According to Rodney and Spindler[9] the useful upper limit is approximately 40 microns.

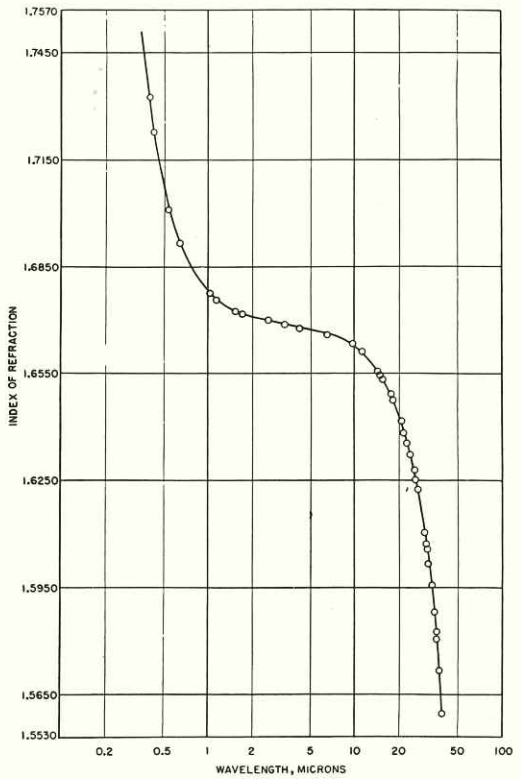


FIGURE 6. Index of refraction of CsBr as a function of wavelength.

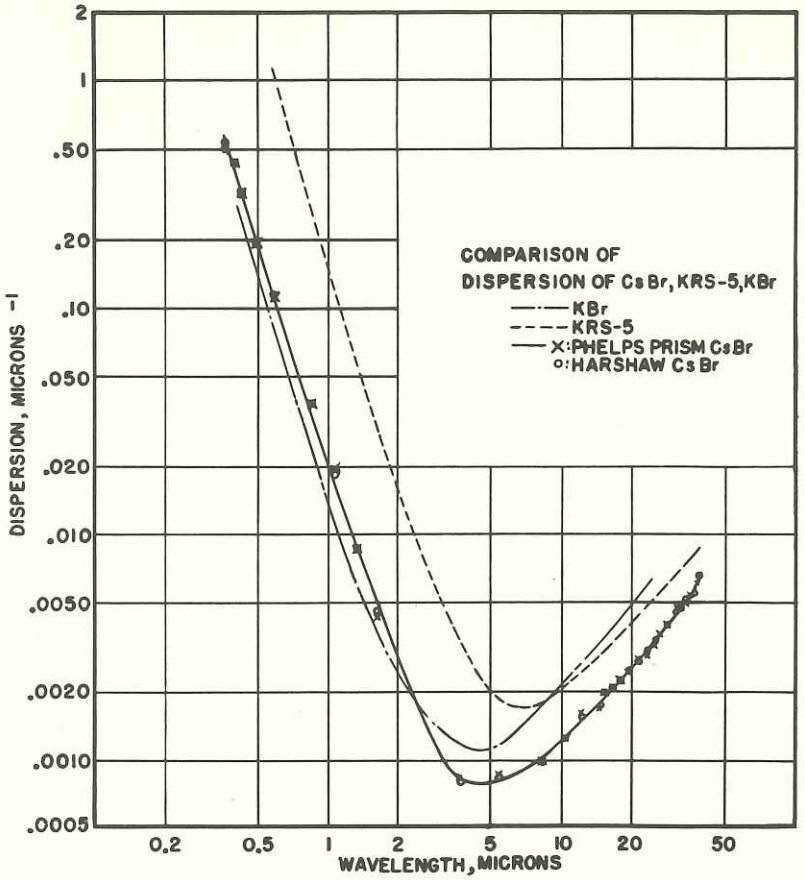


FIGURE 7. Dispersion of CsBr as a function of wavelength.

Cesium Iodide

CRYSTAL CLASS ..... Cubic

CLEAVAGE ..... None

DENSITY 4.510

MELTING POINT ..... 621° C.

SOLUBILITY IN WATER ..... 44 g./100 g. water at 0° C.
160 g./100 g. water at 61° C.

TRANSMISSION RANGE ..... Ballard, Combes and McCarthy[11] report the short wavelength limit as 0.24 microns. Acquista and Plyler[12] give the long wavelength limit as 54 microns. Transmittances of CsI and other window materials at long wavelengths are shown in Figure 8.

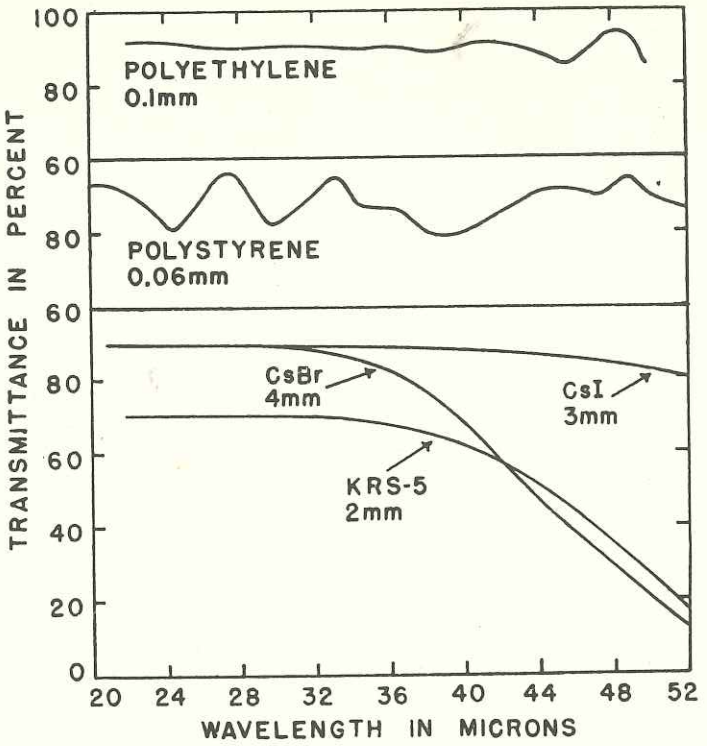


FIGURE 8. Transmittances of polyethylene, polystyrene, CsBr, CsI, and KRS5 from 24 to 52 microns according to Acquista and Plyler.

References Cited

[1]Handbook of Chemistry and Physics, 38th edition, Chemical Rubber Publishing Co., Cleveland, Ohio, 1956.

[2]Paschen, F., Ann. Physik **26,** 120 (1908)

[3]Smakula, A., Physical Properties of Optical Crystals With Special Reference to the Infrared, ERDL, Fort Belvoir, Va., October 1952.

[4]Harrison, G. R., Lord, R. C., Loofbourow, J. R. "Practical Spectroscopy," Prentice-Hall, Inc., N. Y., 1948.

[5]Joos, G., F.I.A.T. Review of German Science, 1939-1946, Part II; The Physics of Solids, Optical Properties of Solids.

[6]Gundelach, E., Z. Physik **66,** 775 (1930).

[7]Melvin, E. H., Phys. Rev. **37,** 1230 (1931).

[8]Sawyer, R. A., "Experimental Spectroscopy", Prentice-Hall, Inc., N. Y., 1944.

[9]Rodney, W. S., and Spindler, R. J., J. Res. Nat. Bur. Stand. **51,** 123 (1953).

[10]Plyler, E. K. and Phelps, F. P., J. Opt. Soc: Am. **41,** 209 (1951).

[11]Ballard, S. S., Combes, L. S., and McCarthy, K. A., J. Opt. Soc. Am. **43,** 975 (1953).

[12]Acquista, N. and Plyler, E. K., J. Opt. Soc. Am. **43,** 977 (1953).